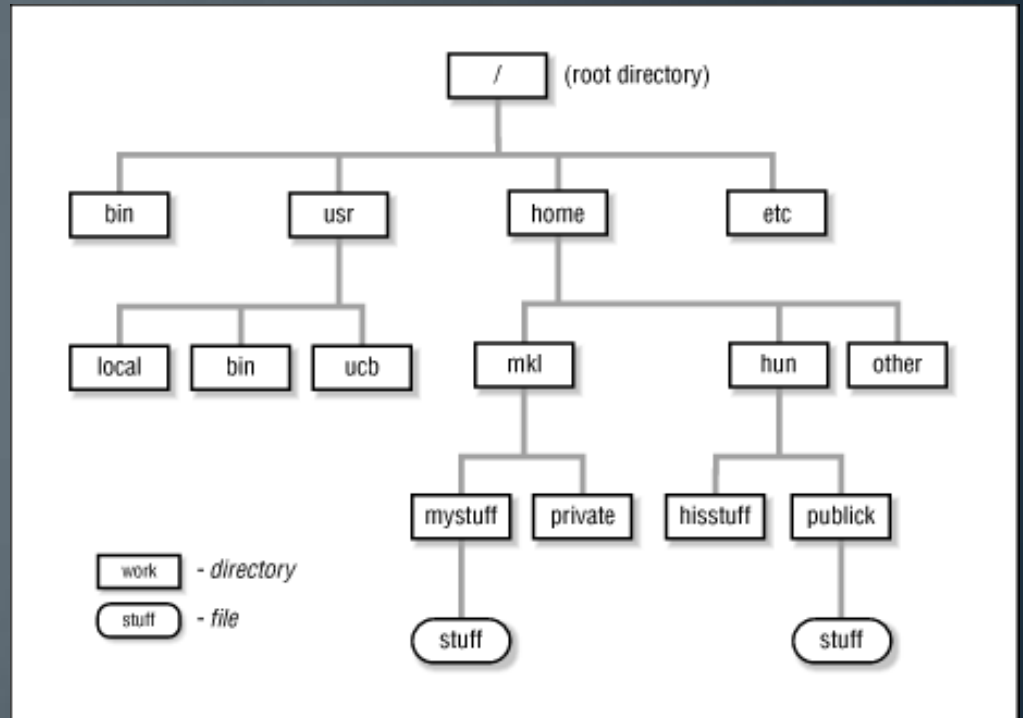# joinFS

By Matthew Harlan

What is joinFS?

- A system for storing files on a computer
  - For Linux!

- A system for automatically organizing files
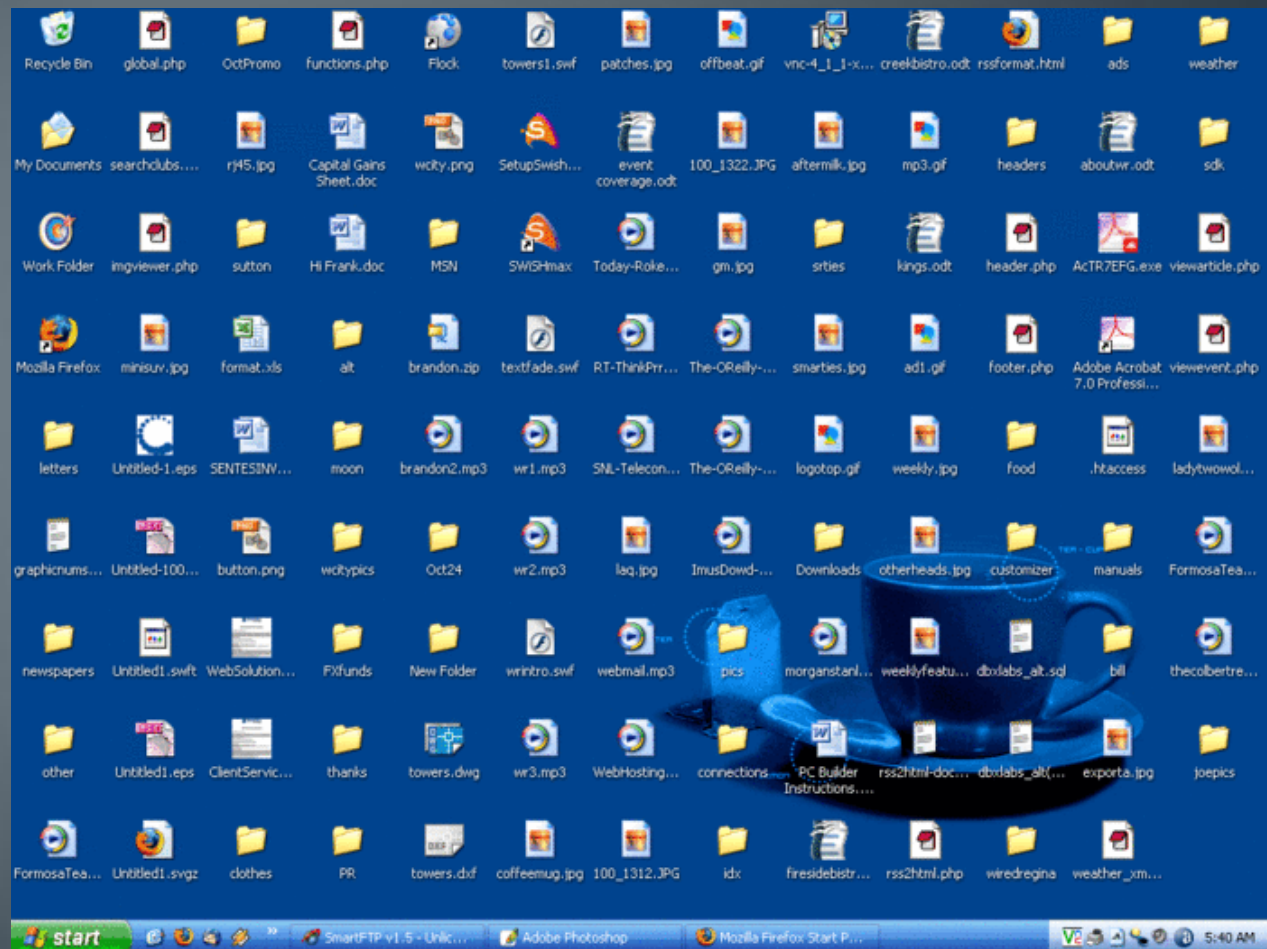
Traditional File Systems

- Folders categorize files

- Hierarchy of categories

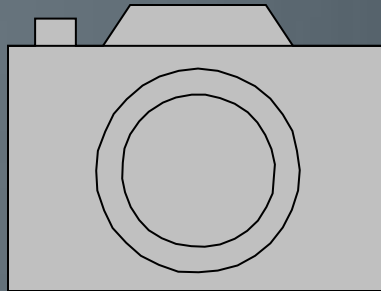- Managed by the user

Users Get Lazy

Hierarchical File Systems Are Dead

- Proclaimed in paper by Margo Seltzer and Nicholas Murphy

- Users have too much data to manage
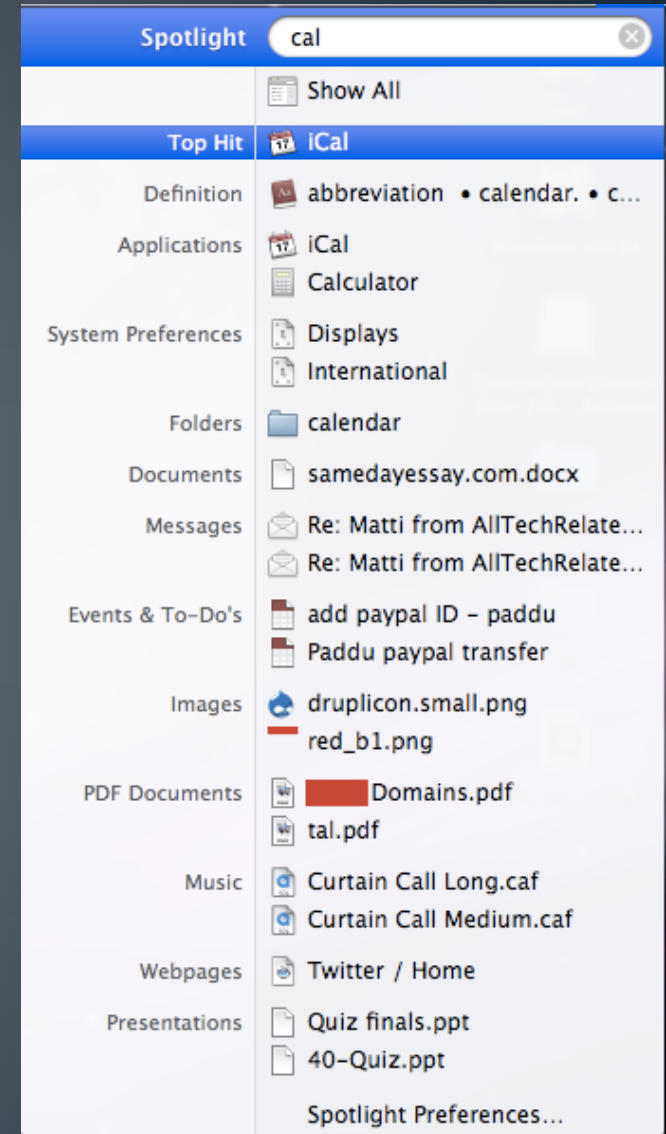
- File systems must incorporate search

Files Are Complex Data

- Most files belong to multiple categories
  - Photos: time, place, people pictured, etc.

Current Solutions

- Windows Search, Spotlight
  - Additional program that runs on top of the file system

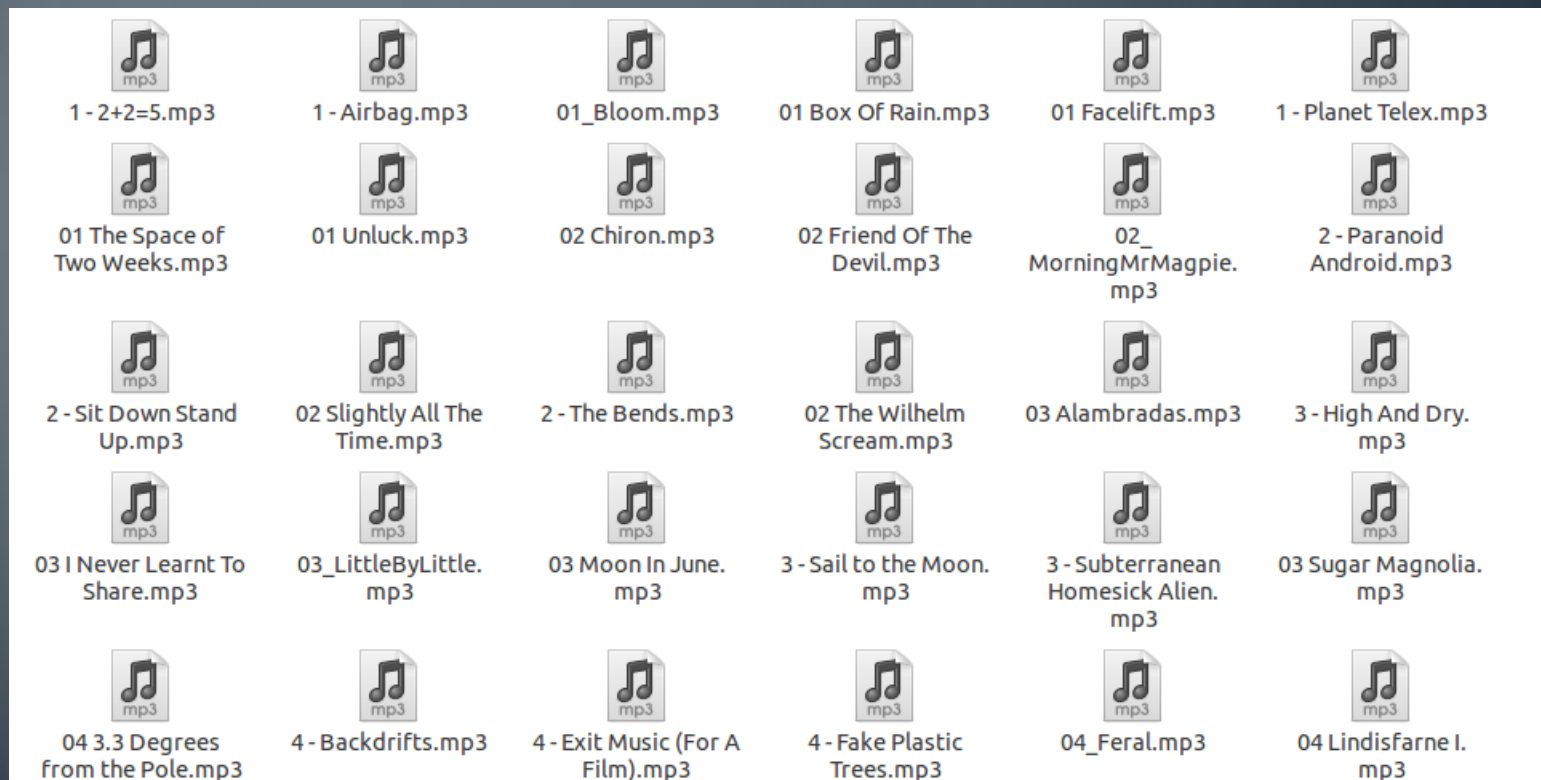 - Searches the file system and returns categorized results

A Natural Next Step

- Represent searches as folders
  - Content is the result of the search!

- Enable users to search for any attribute
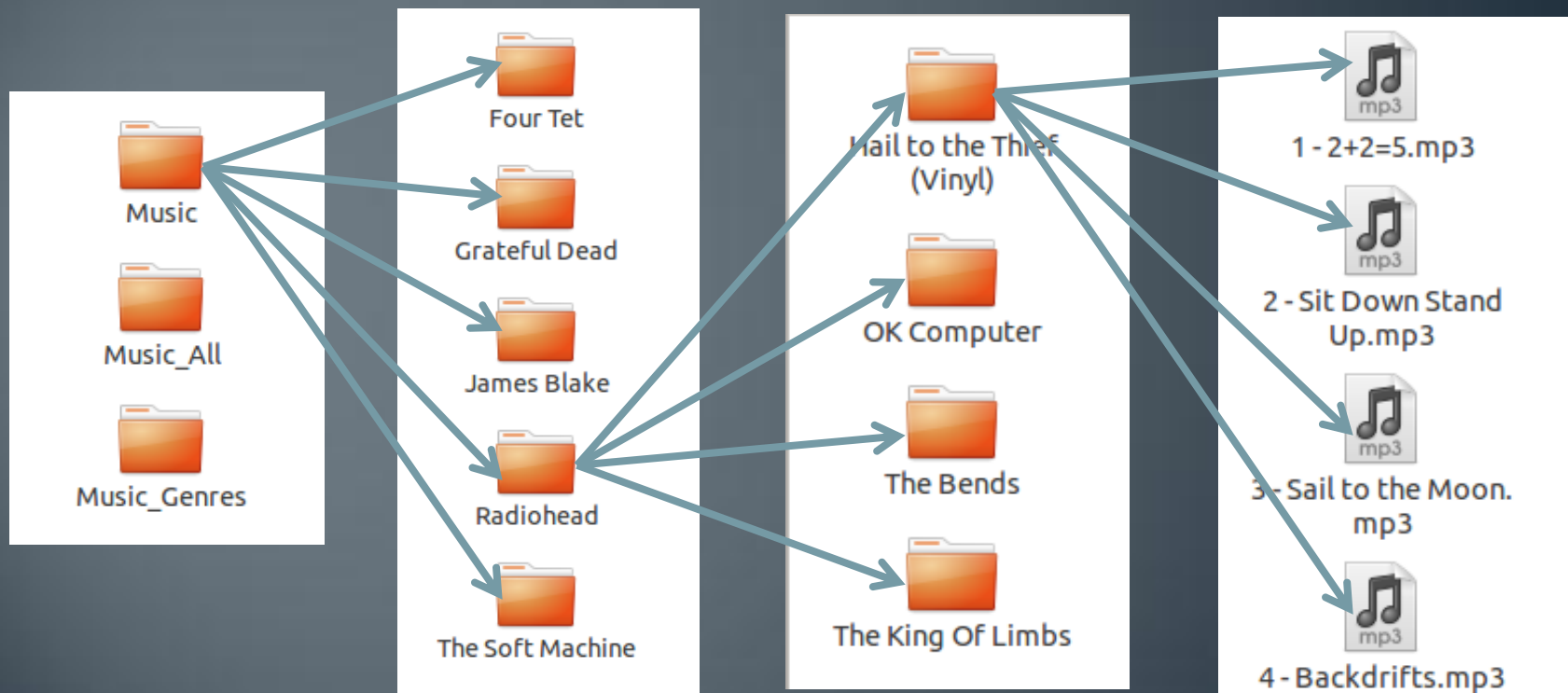
- Allow for a hierarchy of searches

Search Folders

- Turns a folder of unorganized music files into an organized music library

Search Folders

The Demo

- A simple search for all music

- An automatically generated Music Library
  - Music > Artist > Album > MP3 files
  - Music Genres > Genre > Artist > MP3 files

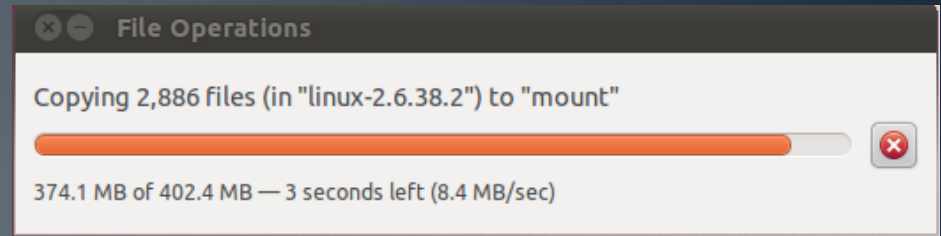- Delete and how it ripples through the hierarchy

Challenges

- Files and folders are stored on the underlying file system
  - Search results are not physically backed

- JoinFS must recognize a search result and return the file that it represents

- Must also maintain access restrictions

Backwards Compatibility

- **Files and Links**: getattr, readlink, mknod, unlink, symlink, rename, link, truncate, open, read, write, flush, release, fsync, create, ftruncate, fgetattr, lock, utimens

- **Extended Attributes (Meta Data)**: setxattr, getxattr, listxattr, removexattr

- **Folders**: mkdir, rmdir, opendir, readdir, realeasedir

- **Security**: chmod, chown, access

- **System**: init, destroy, stafs

Performance

- This is a real file system
  - Performance matters

File Operations

Copying 2,886 files (in "linux-2.6.38.2") to "mount"

374.1 MB of 402.4 MB — 3 seconds left (8.4 MB/sec)

- In February, joinFS took **40 minutes** to transfer about 40,000 files

- Now, it takes joinFS **30 seconds**

The Power of joinFS

- Uses pre-existing Linux file system commands

- Anything can be the result of a search

- You can use joinFS without understanding it

- Any program can use the search functionality

Any Questions?

- Source Code:
  - http://www.github.com/mharlan/joinFS